

# USDA Borlaug Women in Science Fellowship Program

Department of Horticulture –University of Kentucky, Lexington



Borlaug Fellows Final Report  
*Sustainable Vegetable Production*

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By

**MILDRED OSEI-KWARTENG-GHANA**

**12/2009**

*This report focuses on all activities done since arrival in the host institution till December 11<sup>th</sup> 2009 and future plans for the fellowship*  
**MENTOR: Dr. Mark. Williams**

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## **Introduction**

As the purpose of the program is to offer training and collaborative research opportunities for women in international agricultural science, leadership and policy, my focus for this training was to study sustainable cropping systems and practices for vegetable production. It is of great interest because most vegetable farmers in Ghana are using cropping systems which deplete the soil without paying much attention to soil amendment and its long term effects on the fertility of the soil. For this reason the Ministry of Food and Agriculture is advocating for a sustainable land management program for better soil output to enhance food security and alleviate poverty through proper management and sustainable cropping systems.

Moreover the built up of diseases and pest are as a result of the monocropping and continuous cropping of farm lands coupled with the non judicious application of agrochemicals. Exemplary is the epidemic outbreak of thrips attack on spring onions and rot of cabbage in the Kumasi metropolitan assembly where I work. Moreover postharvest problems also arise due to lack of properly planned cropping schedules, unknown marketing outlets for distribution and poor post harvest storage facilities.

## **Profile**

Name: Mildred Osei-Kwarteng

Job Title: Assistant Agriculture Officer

Home Institution and Country: Ministry of Food and Agriculture (Kumasi Metropolitan Assembly)/Ghana

Email Address: misokwart@yahoo.com/naamil1979@yahoo.co.uk

Dates of Program: 3rd October-11th December

U.S. Host University/Research Institution: University of Kentucky, Lexington, Horticulture Department

Borlaug Mentor's Name: Dr. Mark Williams

## **Background**

### **Current Job Position: Assistant Agriculture Officer**

The primary duty of my position is to supervise Agriculture Extension Agents (AEA) in their given operational areas. An operational area has at least 10 neighboring communities under each extension agent with at least a ratio of 1 extension officer to 1500 farmers. The following are my duties,

- DAILY FARM VISITS.
- EXTENDING SOLUTIONS BASED ON FIELD PROBLEMS TO FARMERS.
- CONDUCTING FARMER DEMAND DRIVEN RESEARCH
- EXTENSION OF ENVIRONMENTALLY SUSTAINABLE INNOVATIONS.
- REPORT WRITING.
- CONDUCTING SEMINARS FOR AGRIC EXTENSION AGENTS.
- CONDUCTING FIELD DAYS FOR FARMERS.
- HOLDING ON FARM DEMONSTRATIONS FOR FARMERS

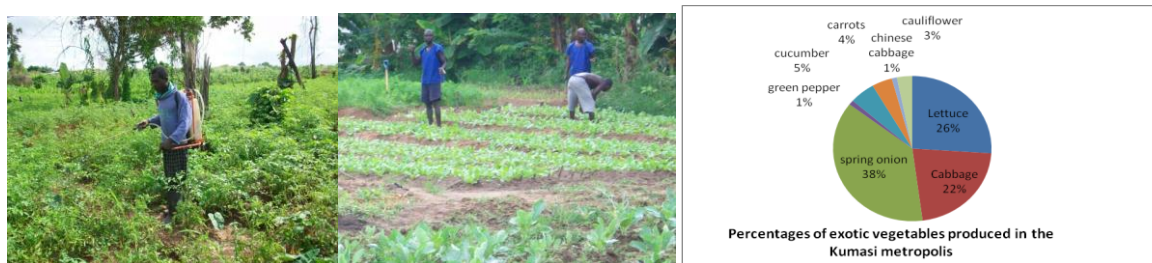
Additionally I work as the vegetable specialist for the Metropolitan Directorate of Agriculture Kumasi and also work on issues pertaining to urban and peri-urban agriculture.



*Mildred having an on-farm discussion with a vegetable farmer discussing the disease outbreak of cabbage on field*

## Research

My research work is on urban and peri-urban agriculture and vegetable production activities in the Kumasi Metropolitan Assembly of Ghana. Current farm practices and systems of farming are being documented to recommend appropriate technologies and good agricultural practices to enhance crop production. Also persisting pest and disease problems are followed and farmer driven research are embarked on. Currently the ongoing farmer driven research is on controlling disease and pest of cabbage and spring onions. The research topic now is ‘Promoting a sustainable crop production (vegetable) in the Kumasi Metropolitan assembly’.



*Some vegetable farmers in the metropolitan area on their daily farm work*

## Academic Background

I hold a Msc. in international Horticulture and majored in vegetable production (2006) which was obtained from the Leibniz University of Hannover, in Hannover Germany. Basically I undertook two years research work on drought stress on broccoli. The outcome of the findings contributed to the published paper (Modeling the effects of drought stress on leaf development in *Brassica oleracea* doubled haploid population using two-phase linear functions).

My Bsc in Agriculture (2003) was obtained at the Kwame Nkrumah University of Science and Technology (KNUST) in Kumasi. I majored in Horticulture and wrote my thesis on indigenous vegetables.

During my National Service I worked at the Department of Horticulture (KNUST) as a teaching assistant.

## Why Borlaug Fellowship Application

Reports from a preliminary survey conducted on urban and peri-urban vegetable production in the Kumasi Metropolis from October 2008 to February 2009, established the major challenges

confronting urban farmers. These were nutrient mining of soils or soil fertility degradation, diseases and pest identification and management (especially of cabbage, lettuce, spring onions, pepper and tomatoes), soil borne diseases, inappropriate use of pesticides, postharvest handling and storage of produce, inadequate and inefficient irrigation facilities, below optimum production systems which results in low yield potential and poor marketing returns during glut periods.

The way forward was looking at the sustainable agriculture that considers farm practices by their impact on water quality, soil productivity, human health, and the local community. Henceforth the sustainable agriculture program in the University of Kentucky was appropriately considered

## **Objectives of Fellowship**

Based on the problems pertaining to vegetable production in the Kumasi Metropolitan Assembly, the following specific objectives were proposed for the fellowship,

1. To determine the current agricultural practices for major vegetables produced in the metropolis and to establish sustainable good agricultural practices towards the judicious use of agrochemicals in making safe produce available to the populace.
2. To develop crop guides towards a sustainable crop production
3. To establish the good agricultural practices for specific vegetables (cabbage lettuce, cucumber, spring onions, green pepper and tomatoes) produced in the metropolis (under tropical conditions)
4. To establish community based demonstration farms on intensive vegetable production
5. To establish beneficial vegetable cropping combinations or intercrops and crop rotational systems
6. To train farmers on timely and efficient harvesting, handling and storage of vegetables
7. To establish a community support agriculture model or system to aid the profitable marketing of vegetables produced by farmers in curbing gluts towards an increased growth in incomes by farmers.

The following objectives will help in extending the needed good agricultural practices and farming systems to our resource poor farmers. Skills acquired from these objectives will be extended to farmers to enable a technical approach to farming in addition to their traditional

farming knowledge. On farm demonstration of practical but simple technologies will strengthen the vertical relationship between extension officers and farmers, because extension agents will be first trained in seminars on principles of sustainable agriculture towards an increased crop production. Moreover techniques on handling and marketing will also be made available to farmers so as to reduce produce loss after harvesting thus reducing poverty and ensuring food security.

Collaboration opportunities with the University of Kentucky, Department of Horticulture, and particularly my mentor in the sustainable agriculture program will help in solving any future challenges arising during the implementation of objectives and any related project.

I am also looking forward to have my PhD studies in sustainable agriculture taking in consideration the problems existing in Ghana in the University of Hannover.

## **Activities**

The following are the activities that were done during my 8 weeks stay in the University of Kentucky.

WEEK	ACTIVITY
ONE	ORIENTATION AND SCHEDULING WITH MENTORS
TWO	WORLD FOOD CONFERENCE IN IOWA
THIRD	INTRODUCTION TO SUSTAINABLE AGRICULTURE AND FARMING ACTIVITIES
FOURTH	PROPOSAL WRITING AND EXPERIMENT SET UP
FIFTH	CROP GUIDE PREPARATION AND DATA TAKING
SIXTH	TWO LECTURE PRESENTATION, RESEARCH AND
SEVENTH	RESEARCH, REPORT WRITING DATA COLLECTION AND BORLAUG FELLOWS PRESENTATION
EIGHT	RESEARCH, COMMUNITY SUPPORT AGRICULTURE AND ROUND UP OF FIELD WORK SCHEDULE
NINTH	AGENT TRAINING ON COMMUNITY SUPPORT AGRICULTURE AND ROUND UP OF DATA COLLECTION

On every Thursday early morning field work was done mainly harvesting, packaging, and washing/cleaning and packing of produce for distribution for the CSA program. Lectures were also attended in the sustainable agriculture program.



## **Description of Activities**

I arrived at the University of Kentucky on the 3rd of October 2009. The following week was engaged in the orientation to the Agriculture College and particularly the Department of Horticulture. The Coordinator for International programs (Dr. Michael Reed) gave a full PowerPoint presentation on the University and Kentucky in whole. Also regions of Kentucky (KY) pertaining to specific agricultural commodities were shown in the presentation.

Kentucky has a total population of about 4 million (Lexington's population is 260,512) and above with five major counties with its state capital being Frankfort. Agriculture forms part of its industry. KY Ranks 4th in number of farms in the U.S with farmland area of 13,843,706 acres, average farm size of 160 acres farmland which covers approximately 54% of KY.

Kentucky is ranked as the number one in thorough bred horse production and value of sales. It is also ranked as the second in the production of alfalfa hay. Lexington by review is ranked as the 15th best place to live by employment and also as the World's Largest Burley Tobacco Market. The University of Kentucky has a student population of 27,209 total students of which 19,292 undergraduate and 5,584 graduates. International students form 5% of the total population.

A meeting was also scheduled with my mentor (Dr.Mark Williams) within the week. I was introduced to most of the faculty members and the team in which my mentor works closely with on the sustainable agriculture program. Discussions were made on the proposed activities after which a final detailed plan was arrived at. Moreover, a visit was made to the Horticultural research farm whereby basically sustainable practices are been established on farm. Various farm equipments and other modified equipments for the sustainable management of the field were also shown. Particularly simple and improvised tools that will be good and not much expensive for Ghana were emphasised.



*From the left shows a simple hoe, advanced or modified hoe with a wheel and a field cultivator, which was been demonstrated by Dr.Mark Williams (Mentor) to Mildred (Borlaug Fellow).*



### **Conferences Attended**

#### **World food Prize conference in Iowa Des Moines**

Participation in the program was from the 12th-16th of October. We were lodged at the Embassy Suites on the River for the period .On the Tuesday 13th October an educational tour to farms and some institutions was done.

The following institutions were visited

Pioneer a DuPont business, North Central Regional Plant Introduction Station and other farms (corn and soya bean fields)

#### **Pioneer a DuPont company**

Pioneer being the world's leading developer and supplier of advanced plant genetics to farmers worldwide seek to increase customer productivity, profitability and develop sustainable agricultural systems for people everywhere. Their services are extended to about 70 countries all over the world. In Africa they can be found in Morocco, Saudi Arabia, Egypt, Ethiopia, Kenya, and South Africa. Apart from these southern countries their operation has not yet come to other African countries especially in West Africa. The company provides commercial (seed marketing), production (production facilities) and Research (research facilities) services.

The company's well developed value chain is an example for development of individual major agricultural commodities towards increased production and economic development in developing countries especially Africa. Most importantly their value chain is such that seeds of major row crops are improved. This has well contributed to food security in the world. Below is an example of the grain value chain.

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### **The Borlaug dialogue**

At the World Food Price Conference there were dialogues on several issues pertaining to agricultural development in the world. The following were some of the dialogues and conversations I sat in.

- Food, Agriculture and National Security in a Globalized World
- "The Role of Private Sector in African Development"
- "Supporting Africa's Strategy for Reducing Rural Poverty: Report Launch and Symposium
- "Driving Development: The Role of Collaborative research
- Agriculture and food security in Africa

### **Conversation:**

- Intelligence and security perspectives on agriculture
- Agricultural security through cooperation
- Gender in agriculture, nutrition, and health
- Agriculture and climate change - Being part of the solution
- Assessing progress in global agriculture

Amongst other remarkable talks/speeches at the conference was that of Bill Gates (Co-chair, the Bill and Melinda Gates Foundation), Dr.Ejeta (World Food Prize Laureate) and Dr Ngongi (President, Alliance for a Green Revolution in Africa (AGRA)).

Bill Gates touched on support for the world's poor farmers and how farming can better the lives of the poor. Thus the main goal of his organisation is empowering small holder farmers to increase their productivity and having markets for their produce. This he said is the world's single-most powerful lever for reducing hunger and poverty. Emphasis was placed on the fact that Green Revolution has not been realised in Africa since the average farmer in Sub-Saharan Africa gets just over half a ton of cereal per acre. An India farmer gets twice that, a Chinese farmer four times that, an American farmer five times that.

Although he mentioned technology and new approaches as engines that transform agriculture in Africa and elaborated on the problem of choosing between sustainability and productivity, thus either a technological approach that increases productivity, or an environmental approach that promotes sustainability. He concluded that both of them should be married for a much greener revolution with factual science informing individuals to choose best and safest technologies for their countries.

He mentioned an on-going collaboration that will provide African farmers with drought tolerant maize by using biotechnology and conventional breeding. This is expected to increase production to about 2million tons during drought in African countries.

He announced a \$120 million new grant that would serve small farmers across the value chain. The package involves funding for legumes that puts nitrogen in the soil, for higher-yielding varieties of sorghum and millet, and for new varieties of sweet potatoes that resist pest and have higher vitamin content.

Additionally training and resources for biotechnology customized to local conditions will be provided to African countries so as to facilitate science based decisions by policy makers. In relation to this, Ghana was commended for being one of the three African countries (including Malawi and Ethiopia) who pledged 10 percent of their national budgets to agriculture. Remarkably Ghana is the only country which has met the 10 percent pledge and is reaching Millennium Development Goal of cutting hunger and poverty in half.

Dr Gebisa Ejeta speech was entitled “The African Green Revolution Need Not Be a Mirage.”Emphasis was also placed on working for the poor. He advocated for African leaders to spearhead developments for a transformative change in agriculture when external funds are provided and also reduce overreliance on external funds for agriculture development. Also collaboration between public-private partnerships together with other external agencies was advocated for African Green Revolution to be realised.



*From right, Esther (Borlaug Fellow from Ghana), Dr Gebisa Ejeta (World Food Prize, 2009 Laureate) and Mildred (Borlaug Fellow from Ghana)*

Dr. Ngongi contributed to the discussions about gender in agriculture, nutrition, and health. He commended one of the largest NGOs in the world (Bangladesh Rural Advance Committee-BRAC) for undertaking different dimensions of poverty (economics, health, education and human rights) and their emergence in 5 African countries.

He suggested that efforts should be made in making women's work remunerative by improving their access to inputs (via agro dealer's activities in communities) and providing credit systems for women without any collateral needs. The value chain was also talked about with emphasis on investments across the value chain that will increase the income of the poor farmers especially women who contribute a lot in agriculture production.

The 2009 World Food Prize Laureate Award Ceremony and banquet dinner was a very successful one whereby all the Borlaug Fellows were recognized and later had interactions with most of the dignitaries who attended the ceremony. This was very helpful because global agricultural information were exchanged.



*From right Mildred and One of the invited guests from Britain having discussions left is Jane (Kenyan), Esther (Ghanaian) and Mildred seated at the Laureate banquet dinner.*

## **Community Support Agriculture (CSA) Agent Training in Louisville-Kentucky**

Community Support Agriculture (CSA) agent training took place at the University of Louisville on the 10th December 2009. Participants were extension agents from different counties in Lexington and Louisville, farmers, lecturers and other graduate and post graduate students.

CSA is a marketing mechanism which is structured in a way that growers will attain funds from consumers before harvest thus potentially eliminating the need for traditional financing.

The equation for CSA concept introduced by Robyn Van En in the US in 1986, relate CSA as,

**“Food producers + food consumers + annual commitment to one another = CSA and untold possibilities.**

Thus there is linkage between farmers, farmers and consumers, consumers and consumers and relationship with the land through good agricultural practices demanded by consumers for a safer food for distribution to individual consumers.

The topic for the training was managing a successful CSA. The following were the training topics.

- Background and experiences
- Planning a CSA: fees, economics, communicating with clientele, promotion
- Harvest/post harvest management
- Infrastructure and equipment
- CSAs – attitudes and experiences, Nuts and Bolts – three years of experience with the UK CSA

The individual speakers on these topics gave in-depth information and advised participants to well consider and plan their CSA considering the communities they are within.

The training was very helpful because marketing of vegetables by farmers in my working community is not remunerative to farmers so a CSA approach will be an appropriate measure to help farmers increase their income.

The only foreseeable obstacle is computer illiteracy or general illiteracy amongst majority of our farmers which will make communicating with emails and other needed software (QuickBooks, QuickBooks and Excel). However the initiative will be taken to establish a CSA.

### Fellowship Activities and Objectives

The objectives of my fellowship are mainly based on sustainable agriculture. Therefore the exposure and experienced gained during the fellowship has opened up a lot of links or avenues and opportunities that will help me upgrade my knowledge and implementation of sustainable farming practices in the communities I work in.

The above activities including the experiment and other on farm experiences that was acquired has given me in depth knowledge and exposure to agriculture as well as new approaches in tackling or solving the problems of our resource poor farmers especially the women.

Name	Affiliation	Position	Role in Fellowship
Dr.Mark Williams	Department of Horticulture (UKy)	, Associate Professor, Landscape Horticulture and Weed Management,	Mentor
Dr Timothy Coolong	Department of Horticulture (UKy)	Assistant Extension Professor, Vegetable Crop	Experimental team
Krista Jacobsen	Department of Horticulture (UKy)	Lecturer, Sustainable Agriculture	Sustainable Agriculture team
Delia Scott	Department of Horticulture (UKy)	Research scientist	Sustainable Agriculture team
Ben Abell	Department of Horticulture (UKy)	Research scientist	Sustainable Agriculture team (Farm manager)
Bob Caudle	Department of Horticulture (UKy)	Post graduate student	Lectured on PCR
Thomas Shearin	Department of Horticulture (UKy)	Systems Analyst	Assistance on laptops
Prof. Lee Meyer	University of Kentucky (UKy),	Extension Professor	Agent training on CSA



**Mildred Osei-Kwarteng –Borlaug Fellow Ghana 2009 (University of Kentucky)**

	Agriculture economics department.		
Dr. Michael Reed	University of Kentucky (UKy), Agriculture economics department	Director, International Programs for Agriculture Direct	Coordinator of the Program
Pam Compton,	Department of Horticulture (UKy)	Administrative Support Associate	Provision of office equipments or stationery
Monica Schuler	Department of Horticulture (UKy)	Administrative Support Associate	Provision of office equipments or stationery
Kwaku Addo	UKy	Dean of Graduate Students	Advice on graduate studies opportunities

### **Experiment Detailed**

Roots and tubers such as cassava, sweet potatoes, yams and cocoyam are crucial to food security in Ghana. Sweet potato in particular are mostly grown by Ghanaian farmers mostly for subsistence and for food security during lean seasons. However one of the major issues exposing farmers to chronic and transitory food shocks (particularly in the off-season), is postharvest loss. There are methods ranging from highly technologies used in storing sweet potatoes such as the Negative Horizontal Ventilation(NHV) in some developed countries to simple methods such as the piecemeal method used by peasant farmers in most African countries including Ghana. Chemical-based systems of crop preservation and high technology systems are expensive for most farmers, least-cost preservation strategies need to be identified. An experiment was established to study the storage of sweet potatoes.

**Title of experiment:** The effect of heat and sodium hypochlorite treatment on the storage life of sweet potatoes cured at 3 weeks after harvesting.

To reduce desiccation and infection by postharvest diseases as well as increasing visual appeal,

Sweet potatoes are normally recommended to be cured immediately after harvesting to promote the healing of harvested wounds at approximately 30°C and relative humidity of 85% - 90% for 4-7 days and stored at a temperature of approximately 13°C and humidity of 85% - 90% after curing.

According to research, hot water treatment (50°C) significantly inhibited sprouting and bleach such as calcium hypochlorite, sodium hypochlorite and chlorine dioxide are allowed as a sanitizer for water and food contact surfaces for organic postharvest systems.

**Objective:** The objective of the study was to investigate hot water treatment (50°C) and sodium hypochlorite treatment on sweet potatoes after a delayed time (3 weeks) of curing on the storage life of sweet potatoes.

**Hypothesis:** Heat treatment and Sodium hypochlorite will prolong the storage life of sweet potatoes cured at three weeks after harvesting.

### **Materials and methods:**

Plant materials:

Sweet potato roots (cv.Beauregard) were harvested on the 8th October 2009, at the University of Kentucky Horticultural Research Farm, Lexington Kentucky. Notably, the sweet potatoes were not carefully handled after harvest, so the ones chosen for the experiment were not high quality ones without blemish that is normally the situation in most farming communities in Africa.

### **Post-harvest treatments:**

#### **Curing**

The curing process used in this experiment poses a limitation to the normally recommended curing conditions. Samples for this experiment were cured at 80°F (26.6°C) day temperature and 60 °F (15.5°C) night temperature. Storage temperature after curing was between 65-70 °F (18.-21 °C). These non standardized conditions give an interesting aspect of the experiment. Also at storage sweet potatoes were packaged in boxes in a room prior to surface sterilization.

### **Sterilization**

A total of ten samples were surface sterilized by washing in a mixture of 4ppm sodium hypochlorite and water for 5mins. Each sample was placed in the solution and removed after the 5 minutes. The removed samples were rinsed and placed on racks for proper ventilation for drying. The other half of the total sample (20 samples) was not surface sterilized.

### **Hot water treatment:**

Half of the washed and unwashed samples were hot water treated in 50 oC for 30 minutes.

The treatments in the experiment were:

- **Unwashed: no washing;**
- **Unwashed, hot water treatment (HWT): no washing and HWT;**
- **Washed: washing with water and sodium hypochlorite solution;**
- **Washed, HWT: hot water treatment after washing with water and sodium hypochlorite solution.**



Mildred washing samples in sodium hypochlorite solution and hot water treatment of sample

**Experimental design:** A completely randomized design with five replications was used for the experiment. A total of 20 samples were used. Treatments were stored at 55°F and humidity of 85%.

### **Assessment of overall rotting**

All roots in each treatment were assessed for the percentage of surface showing visible rotting every week. The decay rate will be calculated for each treatment based on more than 10% of the

surface showing visible rotting of each root. Roots showing extensive rotting (over 50% of the surface) will be removed from the storage room.

### **Sprout of sweet potatoes**

The sprouting rates of sweet potato root were examined after storage. The sprouted root will be determined and expressed as the percentage of the numbers of sprouted roots to total root.

### **Weight loss**

Weight loss was determined during storage by monitoring the change in weight. The weight loss will be recorded and expressed as the percentage of the loss of weight with respect to the initial weight.

**The data collected is attached as a file to this report**

## **Host Institution-Resources**

### **Equipments**

1. Hygrometer: For humidity measurements
2. Sodium hypochlorite for sanitizing sweet potatoes
3. Thermometer for taking hot water temperature
4. Harvesting field knives

### **Books**

1. Sustainable Vegetable Production from Start-Up to Market (Nraes (Series), 104.) (Paperback) Vernon P.Grubinger.
2. Field Plot Technique: LeClerc Leonard Clark: Books
3. Agricultural Experimentation: Design and Analysis (Paperback)
4. World Vegetables: Principles, Production and Nutritive Values. New Price-. Vincent E. Rubatzky, Mas Yamaguchi
5. Vegetable Seed Production Principles.
6. Tropical Vegetable Garden: Principles for Improved and Increased Production, with Application to the Main Vegetable Types (Paperback) Charles-Marie Messiaen
7. Principles of Vegetable Crop Production (Paperback) R. Fordham (Author), A. G. Biggs

8. Organic Vegetable Production: A Complete Guide by Gareth Davies and Margi Lennartsson
9. Horticulture: Principles and Practices (4th Edition) (Hardcover)
10. Practical Horticulture (6th Edition) (Paperback).Laura Williams Rice.
11. The Organic Gardener's Handbook of Natural Insect and Disease Control: A Complete Problem-Solving Guide to Keeping Your Garden and Yard Healthy Without Chemicals (Paperback) by Barbara W. Ellis
12. Organic Vegetable Production: A Complete Guide by Gareth Davies and Margi Lennartsson
13. Crop Rotation on Organic Farms: A Planning Manual
14. An Introduction to Plant Breeding (Paperback).Jack Brown and Peter Caligari
15. Resource Guide for Organic Insect and Disease Management.
16. Advancing Participatory Technology Development: Case studies on Integration into Agricultural Research, Extension and Education
17. Sharing the Harvest: A Citizen's Guide to Community Supported Agriculture, Revised and Expanded (Kindle Edition) by Elizabeth Henderson
18. Rebirth of the Small Family Farm: A Handbook for Starting a Successful Organic Farm Based on the Community Supported Agriculture Concept by Bonnie Gregson Bob Gregson.
19. Making Your Small Farm Profitable: Apply 25 Guiding Principles/Develop New Crops & New Markets/Maximize Net Profits per Acre (Paperback)

## **Achievements/Description of Program**

### **Outcome**

The program met my aspirations and what was proposed was although modified however it was advantageous to me.

My objectives were met based on the principles of sustainable agriculture, whereby all good agricultural practices are used on the land and crop for maximizing crop production and the conscious enrichment of the soil as seasons of production passes by. The ideology of sustainability is basically reducing the use of agricultural inputs such as agrochemicals particularly pesticides so as to have safe and healthy food for consumption and not polluting our environment or damaging our soils. Economically too farmers will also have an increased income. Notable is its site-specific nature of which practices should be chosen according to the needs of pertaining condition.

The following are the challenges that led to the statement of my objectives.

- Nutrient mining of soils or soil fertility degradation,
- Pest identification and management (especially of cabbage, lettuce, spring onions, pepper and tomatoes),
- Soil borne diseases,
- Inappropriate use of pesticides,
- Postharvest handling and storage of produce
- Inadequate and inefficient irrigation facilities
- Below optimum production systems
- Poor marketing of produce.



Pest and disease attack on cabbage and some pesticides used by farmers in Ghana (K.M.A)

My mentor considered all these problems and worked closely with me on the research farm and was taking through healthy farming practices based on sustainable agriculture practices. The following were learnt.

### **Planting systems:**

Three systems are established on the farm. The raised bed (with or without plastics), bare ground, and no till. Each of the systems depends on the site conditions and other cropping objectives.



Raised beds with plastic covering, flat beds being planted by a planter, and no till systems of planting

Success with no-till, as with any other management practice, begins with an awareness of the various conditions affecting crop production in an area.

The no-till system is a sustainable practice that is being extended to farmers in Ghana because of its benefits to the soil and the plant as well. In no-tillage planting systems, a planting is made directly into an essentially unprepared seedbed. The advantage of the system conserves the soil and reduces soil temperature.

However adversely the no-till system may cause different, greater, or more frequent insect, disease, and weed problems than those typical in conventional tillage crop production. Also the system relies on herbicides for spraying.



Bed planting is reported to have increased yields to about 10 % basically when crops are sowed on ridges or beds instead on flats or on farmer's bed with the application of inputs via the surrounding furrows. Also with the use of a proper variety, production costs can fall by 20-30%, and irrigation water requirements can be reduced up to 35% compared to conventional planting on the flat.

**Crop rotation:** Rotations are planned such that different kinds of crops are grown on the same field in a recurrent succession. A four year vegetable rotational plan was used on the research farm. This critically considers cover crops arrangements with cash crops. Crop are usually grouped based on botanical family, harvested anatomical structure, planting arrangements, cultivation practices, timing of planting and harvest, nutrient demand and cultural practices.

**Cover crop:** Cover crops represent a long term investment in soil resources. It helps farmers to reduce the cost of fertilizers pest, disease control and extensive tillage. Legumes such as clover, alfalfa and vetch are used in a row system on the horticulture research farm. This symbiotically fixes nitrogen to the farming system. Cover crops generally lessen the impact of wind and water over soil surface, add organic matter and suppresses weed.



**Field sown to vetch cover crop**

**Soil management:** Management systems to build soil quality are of much importance and basic principles explaining the work of soil organisms also helped in understanding a sustainable soil management system of a living soil for a sustainable cropping. Practices that build soil organisms and humus are employed, since improvement of the soil's physical structure facilitate

easier tillage, increased soil water storage capacity, reduced erosion, better formation and harvesting of root crops, and deeper, more prolific plant root systems. Green manures, crop residues, animal manures and compost serve these purposes. However one has to be mindful of their application not to narrow the C: N ratio as a result of excess nitrogen application which stimulates increased microbial activity that speeds organic matter decomposition.

**Pest management:** Integrated Pest Management (IPM) is practiced on the research farm. The combination of biological, cultural, physical and chemicals at s a last resort are tools employed in controlling pest. Sustainably crops are given a closer watch for scouting of pest and the use of least toxic for selective spraying in controlling pest when all efforts have failed.

**Harvesting:** Harvesting experienced on the farm was efficiently and effectively done through well planned activities. Harvesting and packaging was done on every Thursday morning. Knives, baskets, rubber ties and all other needed harvesting tools were made available each morning. Counting and packaging were done at harvesting. After harvesting all the harvested produce were conveyed on tracks and sent for washing at the washing area. High quality produce are then packed into boxes and kept in a cooling van for later distribution. Notable is the carefulness in harvesting, so to prevent bruises and also poor quality vegetables are not even harvested but left on the field to be incorporated as a green manure later for the enrichment of the soil.



**Marketing strategy:** The community supported agriculture is a marketing system used by the sustainable agriculture program University Kentucky, Department of Horticulture in selling safe and quality farm produce to the community. It involves about 100 people who registered to have fresh produce weekly, for a maximum of 24 weeks during the production season. Although there are several models of the CSA program targeting different institutions with peculiar agreement, the UK one post their plan for the production online for interested individuals to register and pay ahead of production so as to have capital for farm activities. All activities are estimated in arriving at the cost for each subscriber. Surplus food each week is most often sent to food banks and other charities. Also at distribution, menu guides are prepared in helping customers to know what to do with unfamiliar vegetables.

**Relationship of objectives to knowledge and skills provision, collaboration opportunities in enhancing agricultural productivity, economic development and promotion in food security in Ghana.**

The objectives of my fellowship were based on problems being faced by farmers (particularly vegetable farmers) in the Kumasi Metropolitan assembly and at large also addresses the current national agricultural strategic environmental assessment (sustainable land management) of the (Food and Agricultural Development Policy) FASDEP2.

The objectives of my study collectively address four major objectives of the FASDEP2. These are food security and emergency preparedness, increased growth in incomes, sustainable management of land and environment and science and technology applied in food and agriculture development.

The knowledge and skills acquired will be provided via agricultural agents to our resource poor farmers who are the genesis of poverty thus giving opportunities for the pro poor to enhance agricultural productivity in driving economic development.

## **Future Plans**

A great depth of experience and exposure has been acquired through this fellowship. For my colleagues, I will have meetings that will serve as a platform in sharing my experience in the fellowship to update their extension skills and also trainings will be conducted for all extension agents so as to help in the implementation of the acquired knowledge in their various operational areas.

Students will happen to come to our offices to seek information on agricultural practices will be advised on practicing sustainable practices. They will also be encouraged to embrace agriculture holistically so as to make production agriculture sustainable for future generations.

I plan also to strengthen my linkage with researchers so as to help make pest identification and control technical now that we are looking at sustainability. This will help curb the unnecessary or non judicious use of agrochemicals in controlling pest.

Efforts will be made in making policy makers aware of the possible benefits that this fellowship has for agriculture development in Ghana via writings or proposals that will be giving the overall approach in implementation of the knowledge acquired.

Additionally these are the activities that will be incorporated in my work plan for this year,

- Establishment of CSA model in an operational area
- Establishment of a rotational cropping system for vegetables
- Research on organic production of vegetables/judicious and timely use of agrochemicals on vegetable production
- Research on crop rotational plans for Cole crops and pest management

### Description of Future Plans with Mentor

Tentative date of visit: 2nd August-13th August

WEEK	ACTIVITY
1 <sup>st</sup> (2 <sup>nd</sup> August-6 <sup>th</sup> August)	<ol style="list-style-type: none"> <li>1. Orientation to the Ministry of Food and Agriculture /KMA'</li> <li>2. Visitation of farms in the Metropolis</li> <li>3. Lectures on sustainable agriculture for Agriculture Extension Agents (AEAs)</li> <li>4. Lectures on Farm practices</li> <li>5. Forum with farmers in sharing traditional practices and appropriate technologies.</li> </ol>
2 <sup>nd</sup> (9 <sup>th</sup> August-13 <sup>th</sup> August)	<p>Visitation of vegetable farm sites in KMA</p> <p>Touring of other regions in Ghana for exposure to other farming systems and practices in Ghana</p> <p>Fellowship impact assessment</p>
10 <sup>th</sup> August	Departure

The above listed activities will help ascertain the impact of the fellowship as well as bring out a research project that needs to be studied for the sustainable crop production in the metropolis. Positively when funds are available or funds will be sourced for a PhD collaborative work with the University of Kentucky on sustainable agriculture program. The research topic will be based on existing problems in Ghana.

## **Acknowledgement**

I am very grateful to the Almighty God for giving me the grace and capacity to think about Ghana's agriculture in a way that I would want to practically help our resource poor farmers whose needs are rarely met.

To Dr. Norman E. Borlaug, who is rightly known as the father of the Green Revolution, great thanks to your initiative and efforts in establishing your ideas towards improving international agriculture and global food security .May your soul rest in perfect peace.

To the United States Department of Agriculture (USDA) in cooperation with the U.S. Agency for International Development, the U.S. Department of State, and the U.S.Trade and Development Agency, my earnest gratitude is awesome. For having given me such a rare opportunity to build my capacity in my field of specialization. For the USAID officer in Ghana, Mr Ackman together with Madam Elma at the US embassy in Ghana I well acknowledge the excellent cooperation offered in the acquisition of our Visas.

I also appreciate Karen Rao and Natasha for the great work they did in getting us through the program. To Karen I say you are an outstanding and an approachable person.

My sincere gratitude also goes out to the Ashanti Regional Director of Agriculture, Mr George Badu Yeboah , Metro Director of Agriculture, Mr.S.N.A Asante who inspired and helped in diverse ways in making my ambitions a reality. Not also forgetting the Minister of Food and Agriculture, Mr Kwesi Ahwoi who also gave an inspirational talk on making an individual initiative at any corner you are in effecting a change towards a productive and food secured agriculture development in Ghana.

The support of my entire Family, good friends and the love of my sons also takes me to higher visions that make life great, I do really appreciate each one! Not forgetting the inspiration from my deceased father, Mr Anthony Osei-Kwarteng, you have been a pavilion of visions.



**Mildred Osei-Kwarteng –Borlaug Fellow Ghana 2009 (University of Kentucky)**

The warm and sociable company of the other four Borlaug Fellows also needs to be recognized. Mercy (Zambia), Jane (Kenya), Vilma (Ecuador) and Esther (Ghana), your friendship will ever be appreciated.

To our programs director in the University of Kentucky (Dr. Michael Reed), I extend my warmest and heartfelt appreciation for making our stay in Kentucky as comfortable as home is.

To my mentor Dr Mark Williams of the Department of Horticulture and of the sustainable agriculture program, I say you were really a mentor who set good examples through all your duties. In spite of your very tight daily schedules, the Borlaug Fellow you mentored was never left out of your plan .My appreciation also goes to the entire Horticulture department, especially, Delia, Krista, Ben ,Bob , Pam and Monica who in diverse ways helped in making my training very successful and interesting.

To all who helped in diverse ways in making my fellowship a successful one, I say thank you very much!